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Several conclusions from research on visuals are discussed. The particular studies on which these conclusions are based are two multivariate experiments which used programed science demonstrations presented over television and programed verbal materials on the same science principles but presented in self-paced booklets. The level of the presentations was designed for eighth graders. The conclusions are: (1) It is feasible to bring student responses under the control of visual presentations. (2) This kind of control is better established by having students actively practicing responses to features of the presentation rather than passively watching the presentation. (3) If visual presentations are used as a means of teaching concepts, it is preferable to have the visual presentation precede a verbal presentation. (4) When the visual presentation designed to teach concepts does precede the verbal presentation, it is preferable that students select responses from among pictorial options rather than from verbal options. In other words, concept acquisition is better if students respond first to concrete situations and then to more abstract treatment of the same phenomena. (5) It is possible to integrate fixed-paced visual presentations, whether on film or television, with self-paced programed verbal material if the fixed-paced demonstrations and the self-paced verbal programs which follow them are broken down into segments.

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On Integrating Visual and Verbal Programmed Instruction[1]

George L. Gropper

American Institutes for Research

Over the past few years I have given isolated presentations describing the research on visuals I have been doing. Last year some of you may have seen the film "Learning from Visuals"[2] which was presented at the DAVI Convention held in Rochester. Some of you may have also read a paper of mine appearing in the AVCR entitled "Why is a Picture Worth a Thousand Words?". What I would like to do is summarize what are the salient findings about the research which backed up those presentations.

A capsule summary of my main points would be as follows:

1. It is feasible to bring student responses under the control of visual presentations.
2. This kind of control is better brought about by having students actively practicing responses to features of the presentation rather than passively watching the presentation.
3. Using visual presentations as a means of teaching concepts, it is preferable to have the visual presentation precede a verbal presentation.
4. When the visual presentation designed to teach concepts does precede the verbal presentation, it is preferable that students select responses from among pictorial options rather than from verbal options.

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[1]Paper presented at the annual DAVI Convention held in Milwaukee, Wisconsin, April 1965.

[2]Gropper, G. L. Learning from visuals. The application of programming principles to visual presentations. Pittsburgh: American Institutes for Research, 1963. (A film report)

[3]Gropper, G. L. Why is a picture worth a thousand words? Audio-Visual Commun. Rev., 1963, 11, 75-95.

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5. It is possible to integrate fixed-paced visual presentations, whether on film or television, with self-paced, programmed verbal material.

These conclusions are based on two multivariate experiments using programmed science demonstrations presented over television and programmed verbal materials covering the same science principles but presented in self-paced booklets. The level of these presentations was designed for eighth graders. Let's discuss each point in turn.

1 & 2 Bringing student responses under the control of visual presentations through active response practice.

Most, if not all of you, are familiar with the principles and techniques of programmed instruction. The behavioral language describing the aims of programmed instruction generally refers to the bringing of student responses under the control of stimuli. Thus, when you ask the verbal question "What is Archimedes' Principle?" and the student responds by giving a correct statement of the principle, his response is said to be under the control of the verbal stimulus (the question) -- much as your depression of the brake pedal is said to be under the control of the red light at an intersection. Responses are effectively brought under the control of stimuli through their active practice in the presence of those stimuli. If this is true of verbal presentations, should not, for effective learning, responses be brought under the control of visual presentations?

In experiments using Archimedes' Principle as subject matter, an entirely visual lesson was programmed.[4] No verbal commentary accompanied it. Repetitive demonstrations were followed by student response practice, in this instance predicting the outcome of new demonstrations by selecting it from pictorial options describing different possibilities. Student responses were thus brought under the control of the visual presentation and through discrimination practice acquired concepts and principles illustrated in demonstrations. Following the presentations they were able to answer test questions, both visual and verbal, concerning Archimedes' Principle. Their mastery was comparable to that

[4] Gropper, G. L. Controlling student responses during visual presentations - Report #2. Studies in televised instruction: The role of visuals in verbal learning. Pittsburgh: American Institutes for Research (in preparation).

attained by those students who had learned the same material from a solely verbal, programmed lesson.

It is possible to conclude from these findings, that it is feasible to program visual presentations, to bring student responses under their control, and thereby effectively to teach principles and concepts. In a subsequent experiment, using the concept of "pressure" as the subject matter, these findings were replicated. But here, to avoid the inefficiency of using a solely visual lesson, verbal material was used to describe the concrete events in the demonstration, but not, it should be pointed out, to give abstract explanations.

Effective teaching of concepts and principles through visual presentations was accomplished in these two instances through active practice of discriminations about features of the presentation. In fact, an actual comparison of the results of those who were encouraged to practice responding and those who were allowed merely to watch a comparable demonstration, indicates the superiority of the former strategy. Findings supporting the advantage of active participation are in keeping with a considerable body of instructional film research, the one difference being that here responses practiced were discrimination responses programmed to teach concepts and principles.

3 & 4 Response mode employed during visual presentation and the integration of visual and verbal presentations.

In the experiment on "pressure," the visual lesson was divided into segments and each segment was followed by self-paced programmed verbal materials. Using time to complete the verbal programs, a comparison was made between those subjects who responded to the preceding visual segments by selecting responses from pictorial options and those subjects who selected their responses from verbal options covering essentially the same points. The findings indicated, contrary to what some might have expected, that choosing among pictorial options during the visual presentations led to faster mastery of the subsequent verbal program. It was also found that time to complete verbal programs in both experiments was shorter when it was preceded with concept acquisition based on discrimination practice during the visual presentation.

These two findings: (1) that pictorial options are superior to verbal options during the visual presentation and (2) that visual presentations (of the type described here) should precede rather than follow the more abstract verbal program, both suggest the same interpretation. Both suggest the desirability of requiring at each stage learning those responses of which the student is most capable. In this instance, it suggests the advantage for concept acquisition of having students respond first to concrete situations and only then to more abstract treatment of the same phenomena. Having first acquired the concepts or principles on the basis of the concrete visual presentation, the student is then better prepared to acquire the technical language the physicist uses to describe the phenomena. Understanding the principles on the basis of response-practice during the visual presentation, he readily acquires the more abstract, verbal statement of the principles.

These findings suggest the use of the type of discrimination practice during visual presentation (employed in this study) before exposing students to a more abstract verbal presentation. They also suggest as an appropriate mode of response to the visual presentation -- the selection of correct responses from pictorial rather than verbal options. The rationale appears to be the same -- have the student response at the level for which he is prepared. Thus, he is better able during the visual presentation to respond to concrete phenomena presented in pictorial options (with which he has considerable past experience) than to verbal descriptions or explanations of them.

5 The integration of self-paced and fixed-paced instruction.

In self-paced instruction students finish their work at different times, often widely disparate. In fixed-paced instruction (film or television) they all finish at the same time. How can fixed-paced and self-paced media be combined? The study on "pressure" demonstrated that when both the fixed-paced demonstrations and the self-paced verbal programs which followed them are broken down into segments, it is possible to integrate them. With short segments, the fast students do not have too much opportunity to finish much faster than the slow students. The variance in work rate is effectively reduced. Thus, the interval the fast student must wait for the next visual segment (presented at a fixed-pace) after he has completed his self-paced verbal program is not sufficiently long to stimulate boredom or impatience. Thus, the use of short segments devoted to specific facts or concepts permits the combined use of self-paced and fixed-paced programmed materials in group settings.

The most general conclusion of this study is the demonstration of the feasibility and desirability of bringing student responses under control of stimuli used in a visual presentation.